DEPARTMENT OF CHEMISTRY
(Centre for Advanced Studies-UGC)

TEACHING FACULTY

Professor Emeritus & INSA Scientist
Harjit Singh, Ph.D.(PU Chd..)

Professor Emeritus
Tarlok Singh Lobana, Ph.D.(GNDU)

Professor
Rakesh Kumar Mahajan, Ph.D.(GNDU)
Subodh Kumar, Ph.D.(GNDU)
Balwinder Singh Randhawa, Ph.D.(GNDU)
Kamaljit Singh, Ph.D(GNDU)
Tarlok Singh Banipal, Ph.D.(GNDU)
Geeta Hundal, Ph.D.(GNDU)
Manoj Kumar, Ph.D. (GNDU)(Head)
Sukhprit Singh, Ph.D.(GNDU)
Swapandeep Singh Chimni, Ph.D.(GNDU)
Sumanjit Kaur, Ph.D. (PU Patiala)
Damanjit Kaur, Ph.D.(PU Chd.)
Palwinder Singh, Ph.D.(GNDU)
Paramjit Kaur, Ph.D.(GNDU)
Parampaul Kaur, Ph.D. (GNDU)

Assistant Professor
Ashwani Kumar Sood, Ph.D. GNDU
Varinder Kaur, Ph.D (GNDU)
Vandana Bhalla, Ph.D(GNDU)
Inderpreet Kaur, Ph.D(GNDU)
Vipan Kumar, Ph.D(GNDU)
Ritu Bala, Ph.D(PU Chd.)
Parambir Singh Malhi, M.Tech
Prabhpreet Singh, Ph.D(GNDU)
Sachin Kumar, M.Tech
Tejwant Singh. Ph.D.(BU)
Venus Singh Mithu Ph.D. (TIFR)

Courses offered

- B.Sc. (Hons. School)
- M.Sc.(Hons. School)
- M.Sc.
- Ph.D

Course Detail : B.Sc. (Hons. School)

Distribution of seats

Course Name	Duration (Years)	System	Total	Reserved Categories			
			Seats	SC/ST	BC	RA	Others
B.Sc. (Hons. School) Chemistry	3	Semester	100	25	5	8	12

Eligibility

a) Senior Secondary Examination (12th grade) in any science subject with at least 50% marks(45% for SC/ST) in aggregate.
b) Any other examination recognized equivalent thereto.
c) Admission will be based on merit of the candidate in qualifying examination.

Mode of Admission

Admission will be based on merit of the candidate in qualifying examination. The Coordinator of admission shall be Dr. Subodh Kumar, Prof., Department of Chemistry

Dates

a)	Fee deposit date in State Bank of Patiala (Any Branch)	01.06.2016 to 15.06.2016
b)	Last Date for Online application Form submission	03.06.2016 to 23.06.2016
d)	Admission Counseling	06.07.2016 to 09.07.2016

Venue : Guru Nanak Bhavan, GNDU, Amritsar

Contact No.

Coordinator/Head(M) 9501061545

Fee (Approximate) Rs. 20265/-(1st.Sem.) Rs.4800/-(2nd Sem.)

Course Detail : M.Sc. (Hons. School)

Distribution of seats

Course Name	Duration (Years)	System	Total Seats	Reserved Categories			
				SC/ST	BC	RA	Others
M.Sc. (Hons. School) Chemistry	2	Semester	100	25	5	8	12

Eligibility

Bachelor of Science (Hons. School) in Chemistry in GuruNanakDevUniversity with a CGPA of 5.62 (equal to 50%marks(45% for SC/ST) in aggregate)

Mode of Admission

Admission will be based on merit of the candidate in B.Sc. (Hons. School)

Dates

Consult Head of the Department.

Contact No.

Coordinator/Head : 0183-2258802 —09, 2450601 —14, Ext. 3492

Fee (Approximate) Rs. 23965/-(1st.Sem.) Rs.8500/-(2nd Sem.)

Course Detail: M.Sc. Chemistry

Distribution of seats

Course Name	Duration (Years)	System	Total Seats	Reserved Categories			
				SC/ST	BC	RA	Others
M.Sc. Chemistry	2	Semester	50	12	3	4	6

Eligibility

a) Bachelor of Science with Chemistry as one of the subject with at least 50% marks(45% for SC/ST) in aggregate.
b) Any other examination recognized equivalent thereto.

Mode of Admission

Admission will be based on merit of the candidate in the Entrance Test to be conducted by the Department.

Dates

a)	Fee deposit date in State Bank of Patiala (Any Branch)	04.06.2016 to 23.06.2016
b)	Last Date for Online application Form submission	06.06.2016 to 30.06.2016
c)	Entrance Test	12.07.2016 (10.00 a.m. - 11.30 a.m.)
d)	Admission Counseling	15.07.2016

Venue : Guru Nanak Bhavan, GNDU, Amritsar

Contact No.

Coordinator/Head Telephone: 0183-2258802 —09, 2450601-14, Ext. 3492

Fee (Approximate) Rs. 23965/-(1st.Sem.) Rs.8500/-(2nd Sem.)

Syllabus for Entrance Test :

1. Chemical bonding: Covalent Bond-Valence bond theory, hybridization and shapes of inorganic molecules and ions. VSEPR theory, MO theory-homonuclear (elements and ions of 1st and 2nd row) and heteronuclear (BO, CN^-, CO, NO^+, CO^+, CN), diatomic molecules, multicenter bonding in electron deficient molecule (Boranes). Ionic Solids: Concept of close packing, ionic structures (NaCI type, Zinc blende, Wurtzite, CaF_2 and antifluorite), radius ratio rule, lattice defects, semiconductors, lattice energy and Born–Haber cycle, solvation energy and solubility of ionic solids, polarizing power

and polarisability of ions, Fajan's rule. Metallic bond– free electron, valence bond and band theories.Weak Interactions (H-bonding, Vander Waals forces).

2. Acids and bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

3. s and p-block elements: Comparative studies, diagonal relationship, salient features of hydrides, salvation and complexation tendencies of s-block elements. Comparative study (including diagonal relationship) of groups 13–17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13–16, hydrides of boron–diborane and higher boranes, borazine, borohydrides, fullerenes. Carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalide.Inorganic polymers- silicones and phosphazenes.

4. d-block elements: General characteristic properties of *d*–block elements. Comparative properties of 1st, 2nd and 3rd row transition elements with respect to ionic radii and oxidation states, magnetic Properties (types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for characterization of 3d-2metal complexes). Metal-ligand bonding in Transition Metal Complexes: crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

5. f-block elements: Electronic structure, oxidation states, ionic radii, lanthanides and actinides contraction. Electronic absorption and magnetic properties.

6. Coordination Compounds: Werner's coordination theory, effective atomic number concept, chelates, nomenclature and isomerism.

7. Organometallic and bioinorganic chemistry: Classification of organometallic compounds. 18e's rule, preparation, properties and applications of alkyls aryls of lithium and aluminum, bonding in metal-olefin complexes, Mechanism of homogeneous hydrogenation reactions. Essential and trace elements in biological processes, metalloporphyrins and special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.

8. Mechanism of organic reactions

Homolytic and heterolytic bond breaking. Reactive intermediates: carbocations, carbanions, free radicals, carbenes, arenes and nitrenes (structure, synthesis and reactions).

9. Alkanes and cycloalkanes

Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

10. Alkenes and alkynes

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes, mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration reduction.

11. Arenes and aromaticity

Aromaticity: the Huckel's rule. Aromatic electrophilic substitution reactions: role of σ and π complexes. Mechanisms of nitration, halogenation, sulphonation, desulphonation mercuration and Friedel Crafts reaction.

12. Alkyl and aryl halides

Nomenclature and classes of alkyl halides, chemical reactions. Mechanisms of nucleophilic substitution reaction of alkyl halides, SN2 and SN1 reaction mechanisms with energy profile diagrams. Nuclear and side chain reactions of aryl halides.

13. Phenols

Reactions of phenols: electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Reimer Tiemann reaction.

14. Aldehydes and ketones

Synthesis of aldehydes and ketones using 1,3-dithianes. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Witting reaction. Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction. Meerwein-Pondorff-Verley reduction, Clemmensen reduction, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones.

15. Carboxylic acids and derivatives

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

16. Organic compounds of nitrogen

Reactivity, structure and nomenclature of amines, Methods of preparation of amines by reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction and Hofmann bromamide reaction. Physical properties of amines. Structural features effecting basicity of amines.

17. Stereochemistry of organic compounds

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.
Geometric isomerism–determination of configuration of geometric isomers. E & Z system of nomenclature. Conformational isomerism–conformational analysis of ethane and n–butane; conformation of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.

18. Organometallic compounds

Preparation, structure and reactions of Grignard and organolithium reagents.

19. Heterocyclic compounds

Molecular orbital picture and aromaticity of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Comparison of basicity of pyridine, piperidine and pyrrole.

20. Amino acids, peptides, proteins and nucleic acids

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination. Nucleic acids: Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

21. Absorption spectroscopy

Ultraviolet-visible (UV-Vis) absorption spectroscopy: electromagnetic spectrum, Beer-Lambert law, molar absorptivity, types of electronic transitions, effect of conjugation. Concept of chromophores and auxochromes, Bathochromic, hypsochromic, hyperchromic, hypochromic shifts, UV-Vis spectra of conjugated compounds,

Infrared (IR) absorption spectroscopy: introduction, Hooke's law, selection rules, intensity of IR bands, measurement of IR spectrum, concept of FTIR, characterization of IR absorption frequencies of functional groups of simple organic compounds and relevant comparisons.

22. Nuclear Magnetic Resonance (NMR) spectroscopy.

Proton Magnetic Resonance (^{1}H NMR) spectroscopy, Nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin coupling and coupling constants. Concept of deuterium exchange.

23. Colloidal State

Definition of colloids, classification of colloids. Solids in liquids (Sol): kinetic, optical and electrical properties, stability of colloids, protective action, Hardy Schulze law, gold number. Liquids in liquids (emulsions): Types of emulsions, preparation. Emulsifiers. general applications of colloids.

24. Solutions, Dilute Solutions and Colligative Properties

Ideal and non–ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure. Osmosis, Law of osmotic pressure. Elevation of boiling point and depression of freezing point, Molecular weight determination, Abnormal molar mass, degree of dissociation and association of solutes.

25. Thermodynamics-I

Definition of thermodynamic terms: System, surroundings, etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity. Joule's law-Joule-Thomson coefficient and inversion temperature, Calculation of w,q,dU & dH for the expansion of ideal gases.

Thermochemistry: Standard state, standard enthalpy of formation-Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy. Kirchhoff's equation.

26. Thermodynamics-Ⅱ & Ⅲ

Second Law of Thermodynamics: Need for the law, different statements of the law, Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of Entropy : Entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third Law of Thermodynamics: Nernst heat theorem, statement and evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions, criteria for thermodynamic equilibrium and spontaneity, their advantages over entropy change.

27. Introduction to Phase Equilibrium

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO2 and S systems. Phase equilibria of two component systems-solid-liquid equilibria. Solid solutions-compound formation with congruent melting point (Mg-Zn), $FeCl_3$-H_2O) and incongruent melting point, (NaCl-H_2O). $CuSO_4$-H_2O) system. Partially miscible liquids Phenol-water, triethylamine-water, Nicotine-water System. Lower and upper consulate temperature, Effect of impurity on consolute temperature, immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation and applications.

28. Electrochemistry-I

Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and

equivalent conductance. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation, weak and strong electrolytes, Ostwald's dilution law. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number. Applications of conductivity measurements: conductometric titrations.

29. Electrochemistry – Ⅱ

Types of reversible electrodes-gas metal ion, metal ion, metal insolblue salt-anion and redox electrodes. Electrode reactions. Nernst equation, derivation of cell E.M.F. and Single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, electrochemical series. Electrolytic and Galvanic cells, reversible and irreverisible cells. EMF of a cell and its measurements. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K), polarization, over potential and hydrogen overvoltage. Concentration cells with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Buffers-mechanism of buffer action, Henderson-Hazel equation, Hydrolysis of salts. Corrosion-types, theories and methods of combating it.

30. Quantum Mechanics-I

Black-body radiation, Planck's radiation law, Photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom and its defects, Compton effect. de Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box, quantization of energy levels, extension to two and three dimensional boxes, degeneracy.

Special Features

The department of chemistry established in 1971 is one of the oldest departments of Guru Nanak Dev University. The department has earned a repute at the national & international level with the coordination and achievement of the dedicated faculty and non teaching staff. The department has been granted the status of "Centre for Advanced Studies", by UGC, New Delhi with the financial grant of Rs.136 lacs for the period 2008-13 under phase I and again in phase Ⅱ with grant of Rs. 300 lacs (2014-2019). The Department of Science and Technology (DST) also sanctioned a grant of Rs. 256 lacs under FIST for the period 2009-2014 to purchase NMR (400 MHz) & CCD. The state of the art research facilities in the department such as 300 MHz NMR spectrometer, X-Ray powder Diffractometer, IR with variable temperature facility, Mossbauer Spectrometer, Fluorescence Spectrophotometer, CHNS Analyzer, HPLC, Tensiometer, Magnetic Susceptibility Balance, molecular modeling software, DTA-TGA Differential Scanning Calorimeter, Microwave Synthesizer, BET surface analyzer, Vibratory sample Magnetometer, Isothermal Calorimeter and Dynamic Light Scatterer etc. and modern fume-hoods are available in the research laboratories. Most of the students laboratories have been fitted with RO water purifier systems and Electronic balances.

All the faculty members have internet facility, the students have access to internet in the specially designed computer laboratory. The department aims at quality education and research in the field of chemistry. The syllabi are regularly revised from time to time.